CLAIMS

What is Claimed is:

1. A method of characterizing vascular tissue, comprising:

obtaining an intra-vascular ultrasound (IVUS) signal, said IVUS signal comprising RF data backscattered from vascular tissue;

transforming said IVUS signal into at least one other domain;

identifying a plurality of parameters of said transformed signal; and

using said plurality of parameters and previously stored histology data to characterize at least a portion of said vascular tissue.

2. The method of Claim 1, wherein said step of transforming said IVUS signal further comprises transforming said IVUS signal from the time domain into the frequency domain.

3. The method of Claim 1, wherein said step of transforming said IVUS signal further comprises performing a wavelet transformation on said IVUS signal.

4. The method of Claim 2, wherein said step of transforming said IVUS signal further comprises processing said identified portion of said IVUS signal using a fast Fourier transform (FFT).

5. The method of Claim 2, wherein said step of transforming said IVUS signal further comprises processing said identified portion of said IVUS signal using the Welch periodogram.

6. The method of Claim 2, wherein said step of transforming said IVUS signal further comprises processing said identified portion of said IVUS signal using autoregressive power spectrum (AR) analysis.

7. The method of Claim 1, wherein said step of identifying a plurality of parameters further comprises identifying at least two parameters selected from a group consisting of maximum power, minimum power, frequency at maximum power, frequency at minimum power, y intercept, slope, mid-band fit, and integrated backscatter.

8. The method of Claim 1, further comprising transmitting acoustic signals within a vascular object and at least toward said vascular tissue.

9. The method of Claim 1, wherein said step of using said plurality of parameters and previously stored histology data to characterize at least a portion of said vascular tissue further comprises using said plurality of parameters and said previously stored histology data to identify a tissue type of said at least a portion of said vascular tissue, said tissue type being selected from a group consisting of fibrous tissues, fibro-lipidic tissues, calcified necrotic tissues, and calcific tissues.

10. The method of Claim 9, further comprising imaging said at least a portion of said vascular tissue on a display.

11. The method of Claim 10, wherein said step of imaging said at least a portion of said vascular tissue further comprises using a particular color to identify said tissue type of said at least a portion of said vascular tissue.

12. The method of Claim 10, wherein said step of imaging said at least a portion of said vascular tissue on a display further comprises using said IVUS signal to identify a location of said tissue type on said display.

13. A vascular-tissue-characterization system, comprising

a computing device comprising:

a database adapted to store a first set of parameters corresponding to a plurality of vascular tissue types; and

a characterization application electrically connected to said database and adapted to:

receive an intra-vascular ultrasound (IVUS) signal, said IVUS signal representing backscattered data from vascular tissue;

transform said IVUS signal into the frequency domain;

analyze said transformed signal for a plurality of identifiable parameters; and

use said plurality of identifiable parameters and at least a portion of said first set of parameters to characterize at least a portion of said vascular tissue.

14. The vascular-tissue-characterization system of Claim 13, wherein said characterization application is further adapted to transform said at least a portion of said IVUS signal using a fast Fourier transform (FFT).

15. The vascular-tissue-characterization system of Claim 13, wherein said characterization application is further adapted to transform said at least a portion of said IVUS signal using the Welch periodogram.

16. The vascular-tissue-characterization system of Claim 13, wherein said characterization application is further adapted to transform said at least a portion of said IVUS signal using autoregressive power spectrum (AR) analysis.

17. The vascular-tissue-characterization system of Clam 13, wherein said database is further adapted to store at least two parameters corresponding to said plurality of vascular tissue types, said at least two parameters being selected from a group consisting of maximum power, minimum power, frequency at maximum power, frequency at minimum power, y intercept, slope, mid-band fit, and integrated backscatter.

18. The vascular-tissue-characterization system of Claim 13, wherein said characterization application is further adapted to use said plurality of identifiable parameters and said at least a portion of said plurality of parameters stored in said database to identify the tissue type of said at least a portion of said vascular tissue, said tissue type being selected from a group consisting of fibrous tissues, fibro-lipidic tissues, calcified necrotic tissues, and calcific tissues.

19. The vascular-tissue-characterization system of Claim 18, wherein said computing device further comprises a display for imaging said at least a portion of said vascular tissue in a color corresponding to said tissue type.

20. The vascular-tissue-characterization system of Claim 19, wherein said characterization application is further adapted to use said IVUS signal to identify where on said display said at least a portion of said vascular tissue should be imaged.

21. The vascular-tissue-characterization system of Claim 13, further comprising an IVUS console electrically connected to said computing device, said IVUS console adapted to:

acquire said IVUS signal from an IVUS catheter; and

provide said IVUS signal to said computing device.

22. A method of characterizing vascular tissue, comprising;

collecting RF backscatter data from a portion of a vascular object;

using at least said RF backscatter data to construct a first image of said portion of said vascular object;

preparing a histology of said portion of said vascular object;

using said histology to construct a second image of said portion of said vascular object;

characterizing at least a portion of said histology;

identifying a region of interest (ROI) of said second image, said ROI corresponding to said at least a portion of said histology;

identifying at least one landmark common to said first and second images and using said at least one landmark to identify a region of said first image that substantially corresponds to said ROI of said second image;

identifying a portion of said RF backscatter data corresponding to said region of said first image;

identifying at least one parameter of said RF backscatter data; and

storing said at least one parameter and said characterization of said at least a portion of said histology.

23. The method of Claim 22, wherein said step of identifying at least one parameter further comprises performing a frequency transformation on said portion of said RF backscatter data before said at least one parameter is identified.

24. The method of Claim 22, wherein said step of identifying at least one parameter further comprises performing a wavelet transformation on said portion of said RF backscatter data before said at least one parameter is identified.

25. The method of Claim 22, wherein said step of identifying at least one landmark further comprises applying a morphometric algorithm to align the at least one landmark of said second image to substantially match the at least one landmark of said first image.

26. The method of Claim 25, wherein said step of identifying at least one landmark further comprises aligning the non-landmark portions of said first and second images based on a thin plate algorithm.

27. The method of Claim 22, wherein said step of characterizing at least a portion of said histology further comprises identifying a tissue type, said tissue type being selected from a group consisting of fibrous tissues, fibro-lipidic tissues, calcified necrotic tissues, and calcific tissues.

28. The method of Claim 23, wherein said step of performing a frequency transformation further comprises using a fast Fourier transform (FFT).

29. The method of Claim 23, wherein said step of performing a frequency transformation further comprises using the Welch periodogram

30. The method of Claim 23, wherein said step of performing a frequency transformation further comprises using autoregressive power spectrum (AR) analysis.

31. The method of Claim 22, wherein said step of identifying at least one parameter further comprises identifying said at least one parameter from a group consisting of maximum power, minimum power, frequency at maximum power, frequency at minimum power, y intercept, slope, mid-band fit, and integrated backscatter.

32. The method of Claim 22, further comprising:

collecting a second set of RF backscatter data from a second vascular object;

performing a frequency transformation on at least a portion of said second set of RF backscatter data to produce a third set of data;

identifying at least another parameter from a third set of data; and

using said at least another parameter, said at least one parameter and said characterization of said at least a portion of said histology to characterize at least a portion of said second vascular object.

33. A vascular-tissue-characterization system, comprising:

a computing device comprising:

a database; and

a characterization application electrically connected to said database and adapted to:

receive intra-vascular ultrasound (IVUS) data corresponding to a portion of a vascular object and digitized data corresponding to a histology of said portion of said vascular object;

use at least said IVUS data and said digitized data to construct a first and second image, respectively, of said portion of said vascular object;

receive characterization data corresponding to a region of interest (ROI) of said second image;

use at least one landmark to morph said second image to substantially match said first image and to identify said ROI on said first image;

identify a portion of said IVUS data corresponding to said ROI on said first image;

identify at least one parameter related to said portion of said IVUS data; and

store said at least one parameter and said characterization data in said database.

34. The vascular-tissue-characterization system of Claim 33, wherein said characterization application is further adapted to perform a spectral analysis on said IVUS data before said at least one parameter is identified.

35. The vascular-tissue-characterization system of Claim 34, wherein said characterization application is further adapted to perform a fast Fourier transform (FFT).

36. The vascular-tissue-characterization system of Claim 34, wherein said characterization application is further adapted to perform the Welch periodogram.

37. The vascular-tissue-characterization system of Claim 35, wherein said characterization application is further adapted to perform autoregressive power spectrum (AR) analysis.

38. The vascular-tissue-characterization system of Claim 33, wherein said at least one parameters is selected from a group consisting of maximum power, minimum power, frequency at maximum power, frequency at minimum power, y intercept, slope, mid-band fit, and integrated backscatter.

39. The vascular-tissue-characterization system of Claim 33, wherein said characterization data comprises a tissue type, said tissue type being selected from a group consisting of fibrous tissues, fibro-lipidic tissues, calcified necrotic tissues, and calcific tissues.

40. The vascular-tissue-characterization system of Claim 34, wherein said characterization application is further adapted to analyze said IVUS data to identify at least one location corresponding to said at least one parameter.

41. The vascular-tissue-characterization system of Claim 33, further comprising an input device electrically connected to said computing device, said characterization data being provided by said input device.

42. The vascular-tissue-characterization system of Claim 33, further comprising an IVUS console adapted to:

acquire said IVUS data from said vascular object; and

provide said IVUS data to said computing device.

43. The vascular-tissue-characterization system of Claim 42, further comprising an IVUS catheter having at least one transducer, said IVUS catheter being electrically connected to said IVUS console and adapted to acquire said IVUS data from said vascular object.

44. The vascular-tissue-characterization system of Claim 33, wherein said characterization application is further adapted to use a morphometric algorithm to align the at least one landmark of said second image to substantially match the at least one landmark of said first image.

45. The vascular-tissue-characterization system of Claim 44, wherein said characterization application is further adapted to align the non-landmark portions of said first and second images based on a thin plate algorithm.

46. A method of characterizing a vascular object, comprising:

providing a classification table comprising a plurality of tissue types and corresponding characteristics;

acquiring an intra-vascular ultrasound (IVUS) image;

selecting a region of the IVUS image;

identifying a plurality of parameters corresponding to said region of said IVUS image;

using said plurality of parameters and said classification table to determine a tissue type corresponding to said region of said IVUS image; and

applying a color scheme to said tissue type, said color scheme being used to differentiate between different tissue types once displayed.

47. The method of Claim 46, further comprising performing frequency analysis on IVUS data corresponding to said region of said IVUS image before said plurality of parameters are identified.

48. A method for generating a tissue map, comprising the steps of:

obtaining an intra-vascular ultrasound (IVUS) signal;

transforming the IVUS signal into the frequency domain; and

analyzing the signal based in at least two parameters selected from the group consisting of maximum power, minimum power, frequencies at maximum power, frequency at minimum power, y intercept, slope, mid-band fit, and integrated backscatter.

49. A method for generating a tissue map, comprising the steps of:

obtaining an intra-vascular ultrasound (IVUS) signal;

transforming the IVUS signal into the frequency domain;

analyzing the signal based on at least one parameter selected from the group consisting of maximum power, minimum power, frequencies at maximum power, frequency at minimum power, y intercept, slope, mid-band fit, and integrated backscatter; and

classifying the tissue properties based on matching the analyzed data with a database.